Practitioner's Docket No. TRW 2 0269

CHAPTER II

Preliminary Classification:

Proposed Class:

Subclass:

NOTE: *"All applicants are requested to include a preliminary classification on newly filed patent applications. The preliminary classification, preferably class and subclass designations, should be identified in the upper right-hand corner of the letter of transmittal accompanying the application papers, for example 'Proposed Class 2, subclass 129.'" M.P.E.P., § 601, 7th ed.*

TRANSMITTAL LETTER TO THE UNITED STATES ELECTED OFFICE (EO/US)

(ENTRY INTO U.S. NATIONAL PHASE UNDER CHAPTER II)

PCT/DE99/03472	October 29, 1999	November 5, 1998
INTERNATIONAL APPLICATION NO.	INTERNATIONAL FILING DATE	PRIORITY DATE CLAIMED

TITLE OF INVENTION ELECTROMOTIVE DRIVE SYSTEM FOR USE WITH A PUMP OF A POWER-ASSISTED STEERING SYSTEM IN A MOTOR VEHICLE (As Amended)

APPLICANT(S)

PETER, Cornelius; VON DER HEIDE, Johann; and, PETACH, Michael

Box PCT
Assistant Commissioner for Patents
Washington D.C. 20231

ATTENTION: EO/US

CERTIFICATION UNDER 37 C.F.R. § 1.10*
(Express Mail label number is mandatory.)
(Express Mail certification is optional.)

I hereby certify that this Transmittal Letter and the papers indicated as being transmitted therewith is being deposited with the United States Postal Service on this date May 4, 2001, in an envelope as "Express Mail Post Office to Addressee" Mailing Label Number EL 852678545 US, addressed to the: Assistant Commissioner for Patents, Washington, D.C. 20231.

Barbara J. Whaley
(type or print name of person mailing paper)

Barbara J. Whaley
Signature of person mailing paper

WARNING: *Certificate of mailing (first class) or facsimile transmission procedures of 37 C.F.R. § 1.8 cannot be used to obtain a date of mailing or transmission for this correspondence.*

*WARNING: *Each paper or fee filed by "Express Mail" **must** have the number of the "Express Mail" mailing label placed thereon prior to mailing. 37 C.F.R. § 1.10(b).*
*"Since the filing of correspondence under § 1.10 without the Express Mail mailing label thereon is an oversight that can be avoided by the exercise of reasonable care, requests for waiver of this requirement will **not** be granted on petition." Notice of Oct. 24, 1996, 60 Fed. Reg. 56,439, at 56,442.*

2. Fees

CLAIMS FEE	(1) FOR	(2) NUMBER FILED	(3) NUMBER EXTRA	(4) RATE	(5) CALCULATIONS
☒*	TOTAL CLAIMS 20	-20=	0	x $18.00=	$
	INDEPENDENT CLAIMS 4	-3=	1	x $78.00=	80.00
	MULTIPLE DEPENDENT CLAIM(S) (if applicable)			+ $260.00	
BASIC FEE**	☐ U.S. PTO WAS INTERNATIONAL PRELIMINARY EXAMINATION AUTHORITY Where an international preliminary examination fee as set forth in § 1.482 has been paid on the international application to the U.S. PTO: ☐ and the international preliminary examination report states that the criteria of novelty, inventive step (non-obviousness) and industrial activity, as defined in PCT Article 33(1) to (4) have been satisfied for all the claims presented in the application entering the national stage (37 C.F.R. § 1.492(a)(4)) ..... $96.00 ☐ and the above requirements are not met (37 C.F.R. § 1.492(a)(1)) ..... $670.00 ☒ U.S. PTO WAS NOT INTERNATIONAL PRELIMINARY EXAMINATION AUTHORITY Where no international preliminary examination fee as set forth in § 1.482 has been paid to the U.S. PTO, and payment of an international search fee as set forth in § 1.445(a)(2) to the U.S. PTO: ☐ has been paid (37 C.F.R. § 1.492(a)(2)) ..... $760.00 ☐ has not been paid (37 C.F.R. § 1.492(a)(3)) ..... $970.00 ☒ where a search report on the international application has been prepared by the European Patent Office or the Japanese Patent Office (37 C.F.R. § 1.492(a)(5)) $840.00				860.00
	Total of above Calculations				= 940
SMALL ENTITY	Reduction by 1/2 for filing by small entity, if applicable. Affidavit must be filed also. (note 37 C.F.R. § 1.9, 1.27, 1.28)				-
	Subtotal				940.00
	Total National Fee				$ 940.00
	Fee for recording the enclosed assignment document $40.00 (37 C.F.R. § 1.21(h)). (See item 13 below). See attached "ASSIGNMENT COVER SHEET".				
TOTAL	Total Fees enclosed				$ 940.00

NOTE: To avoid abandonment of the application, the applicant shall furnish to the USPTO, not later than 20 months from the priority date: (1) a copy of the international application, unless it has been previously communicated by the International Bureau or unless it was originally filed in the USPTO; and (2) the basic national fee (see 37 C.F.R. § 1.492(a)). The 30-month time limit may not be extended. 37 C.F.R. § 1.495.

WARNING: Where the items are those which can be submitted to complete the entry of the international application into the national phase are subsequent to 30 months from the priority date the application is still considered to be in the international state and if mailing procedures are utilized to obtain a date the express mail procedure of 37 C.F.R. § 1.10 must be used (since international application papers are not covered by an ordinary certificate of mailing—See 37 C.F.R. § 1.8.

NOTE: Documents and fees must be clearly identified as a submission to enter the national state under 35 U.S.C. § 371 otherwise the submission will be considered as being made under 35 U.S.C. § 111. 37 C.F.R. § 1.494(f).

I. Applicant herewith submits to the United States Elected Office (EO/US) the following items under 35 U.S.C. § 371:

a. ☒ This express request to immediately begin national examination procedures (35 U.S.C. § 371(f)).

b. ☒ The U.S. National Fee (35 U.S.C. § 371(c)(1)) and other fees (37 C.F.R. § 1.492) as indicated below:

*See attached Preliminary Amendment Reducing the Number of Claims.

I. ☒ A check in the amount of $790.00 to cover the above fees is enclosed.

II. ☐ Please charge Account No. _____ in the amount of $ _____. A duplicate copy of this sheet is enclosed.

**WARNING: *"To avoid abandonment of the application the applicant shall furnish to the United States Patent and Trademark Office not later than the expiration of 30 months from the priority date: * * * (2) the basic national fee (see § 1.492(a)). The 30-month time limit may not be extended." 37 C.F.R. § 1.495(b).*

WARNING: If the translation of the international application and/or the oath or declaration have not been submitted by the applicant within thirty (30) months from the priority date, such requirements may be met within a time period set by the Office. 37 C.F.R. § 1.495(b)(2). The payment of the surcharge set forth in § 1.492(e) is required as a condition for accepting the oath or declaration later than thirty (30) months after the priority date. The payment of the processing fee set forth in § 1.492(f) is required for acceptance of an English translation later than thirty (30) months after the priority date. Failure to comply with these requirements will result in abandonment of the application. The provisions of § 1.136 apply to the period which is set. Notice of Jan. 3, 1993, 1147 O.G. 29 to 40.

3. ☒ A copy of the International application as filed (35 U.S.C. § 371(c)(2)):

NOTE: Section 1.495 (b) was amended to require that the basic national fee and a copy of the international application must be filed with the Office by 30 months from the priority date to avoid abandonment. "The International Bureau normally provides the copy of the international application to the Office in accordance with PCT Article 20. At the same time, the International Bureau notifies applicant of the communication to the Office. In accordance with PCT Rule 47.1, that notice shall be accepted by all designated offices as conclusive evidence that the communication has duly taken place. Thus, if the applicant desires to enter the national stage, the applicant normally need only check to be sure the notice from the International Bureau has been received and then pay the basic national fee by 30 months from the priority date." Notice of Jan. 7, 1993, 1147 O.G. 29 to 40, at 35-36. See item 14c below.

a. ☒ is transmitted herewith.

b. ☐ is not required, as the application was filed with the United States Receiving Office.

c. ☒ has been transmitted

i. ☒ by the International Bureau.
Date of mailing of the application (from form PCT/1B/308): date unknown

ii. ☐ by applicant on _____ *(Date).*

4. ☒ A translation of the International application into the English language (35 U.S.C. § 371(c)(2)):

a. ☒ is transmitted herewith.

b. ☐ is not required as the application was filed in English.

c. ☐ was previously transmitted by applicant on _____ *(Date).*

d. ☐ will follow.

5. ☒ Amendments to the claims of the International application under PCT Article 19 (35 U.S.C. § 371(c)(3)):

NOTE: *The Notice of January 7, 1993 points out that 37 C.F.R. § 1.495(a) was amended to clarify the existing and continuing practice that PCT Article 19 amendments must be submitted by 30 months from the priority date and this deadline may not be extended. The Notice further advises that: "The failure to do so will not result in loss of the subject matter of the PCT Article 19 amendments. Applicant may submit that subject matter in a preliminary amendment filed under section 1.121. In many cases, filing an amendment under section 1.121 is preferable since grammatical or idiomatic errors may be corrected." 1147 O.G. 29-40, at 36.*

a. ☐ are transmitted herewith.

b. ☒ have been transmitted

i. ☒ by the International Bureau.
Date of mailing of the amendment (from form PCT/1B/308): 18 May 2000

ii. ☐ by applicant on _____ *(Date).*

c. ☐ have not been transmitted as

i. ☐ applicant chose not to make amendments under PCT Article 19.
Date of mailing of Search Report (from form PCT/ISA/210.): _____

ii. ☐ the time limit for the submission of amendments has not yet expired. The amendments or a statement that amendments have not been made will be transmitted before the expiration of the time limit under PCT Rule 46.1.

6. ☒ A translation of the amendments to the claims under PCT Article 19 (38 U.S.C. § 371(c)(3)):

a. ☒ is transmitted herewith.

b. ☐ is not required as the amendments were made in the English language.

c. ☐ has not been transmitted for reasons indicated at point 5(c) above.

7. ☒ A copy of the International examination report (PCT/IPEA/409)

☒ is transmitted herewith.

☐ is not required as the application was filed with the United States Receiving Office.

8. ☐ Annex(es) to the International preliminary examination report

a. ☐ is/are transmitted herewith.

b. ☐ is/are not required as the application was filed with the United States Receiving Office.

9. ☐ A translation of the annexes to the international preliminary examination report

a. ☐ is transmitted herewith.

b. ☐ is not required as the annexes are in the English language.

10. ☒ An oath or declaration of the inventor (35 U.S.C. § 371(c)(4)) complying with 35 U.S.C. § 115
   a. ☐ was previously submitted by applicant on ______________ *(Date)*.
   b. ☐ is submitted herewith, and such oath or declaration
      i. ☐ is attached to the application.
      ii. ☐ identifies the application and any amendments under PCT Article 19 that were transmitted as stated in points 3(b) or 3(c) and 5(b); and states that they were reviewed by the inventor as required by 37 C.F.R. § 1.70.
   c. ☒ will follow.

II. Other document(s) or information included:

11. ☒ An International Search Report (PCT/ISA/210) or Declaration under PCT Article 17(2)(a):
   a. ☒ is transmitted herewith.
   b. ☒ has been transmitted by the International Bureau.
      Date of mailing (from form PCT/IB/308): 18 May 2000
   c. ☐ is not required, as the application was searched by the United States International Searching Authority.
   d. ☐ will be transmitted promptly upon request.
   e. ☐ has been submitted by applicant on ______________ *(Date)*.

12. ☒ An Information Disclosure Statement under 37 C.F.R. §§ 1.97 and 1.98:
   a. ☒ is transmitted herewith.
      Also transmitted herewith is/are:
      ☒ Form PTO-1449 (PTO/SB/08A and 08B).
      ☒ Copies of citations listed.
   b. ☐ will be transmitted within THREE MONTHS of the date of submission of requirements under 35 U.S.C. § 371(c).
   c. ☐ was previously submitted by applicant on ______________ *(Date)*.

13. ☐ An assignment document is transmitted herewith for recording.
   A separate ☐ "COVER SHEET FOR ASSIGNMENT (DOCUMENT) ACCOMPANYING NEW PATENT APPLICATION" or ☐ FORM PTO 1595 is also attached.

____

____

____

(Transmittal Letter to the United States Elected Office (EO/US) [13-18]—page 6 of 8)

14. ☒ Additional documents:

a. ☒ Copy of request (PCT/RO/101)

b. ☒ International Publication No. WO 00/28641

i. ☐ Specification, claims and drawing

ii. ☒ Front page only

c. ☐ Preliminary amendment (37 C.F.R. § 1.121)

d. ☐ Other

Voluntary Submission of Substitute Specification; Preliminary Amendment

15. ☒ The above checked items are being transmitted

a. ☒ before 30 months from any claimed priority date.

b. ☐ after 30 months.

16. ☐ Certain requirements under 35 U.S.C. § 371 were previously submitted by the applicant on _____, namely:

AUTHORIZATION TO CHARGE ADDITIONAL FEES

WARNING: Accurately count claims, especially multiple dependant claims, to avoid unexpected high charges if extra claims are authorized.

NOTE: "A written request may be submitted in an application that is an authorization to treat any concurrent or future reply, requiring a petition for an extension of time under this paragraph for its timely submission, as incorporating a petition for extension of time for the appropriate length of time. An authorization to charge all required fees, fees under § 1.17, or all required extension of time fees will be treated as a constructive petition for an extension of time in any concurrent or future reply requiring a petition for an extension of time under this paragraph for its timely submission. Submission of the fee set forth in § 1.17(a) will also be treated as a constructive petition for an extension of time in any concurrent reply requiring a petition for an extension of time under this paragraph for its timely submission." 37 C.F.R. § 1.136(a)(3).

NOTE: "Amounts of twenty-five dollars or less will not be returned unless specifically requested within a reasonable time, nor will the payer be notified of such amounts; amounts over twenty-five dollars may be returned by check or, if requested, by credit to a deposit account." 37 C.F.R. § 1.26(a).

☒ The Commissioner is hereby authorized to charge the following additional fees that may be required by this paper and during the entire pendency of this application to Account No. 06-0308

☒ 37 C.F.R. § 1.492(a)(1), (2), (3), and (4) (filing fees)

WARNING: Because failure to pay the national fee within 30 months without extension (37 C.F.R. § 1.495(b)(2)) results in abandonment of the application, it would be best to always check the above box.

☒ 37 C.F.R. § 1.492(b), (c) and (d) (presentation of extra claims)

NOTE: Because additional fees for excess or multiple dependent claims not paid on filing or on later presentation must only be paid or these claims cancelled by amendment prior to the expiration of the time period set for response by the PTO in any notice of fee deficiency (37 C.F.R. § 1.492(d)), it might be best not to authorize the PTO to charge additional claim fees, except possible when dealing with amendments after final action.

☒ 37 C.F.R. § 1.17 (application processing fees)

☒ 37 C.F.R. § 1.17(a)(1)-(5) (extension fees pursuant to § 1.136(a).

☐ 37 C.F.R. § 1.18 (issue fee at or before mailing of Notice of Allowance, pursuant to 37 C.F.R. § 1.311(b))

NOTE: Where an authorization to charge the issue fee to a deposit account has been filed before the mailing of a Notice of Allowance, the issue fee will be automatically charged to the deposit account at the time of mailing the notice of allowance. 37 C.F.R. § 1.311(b).

NOTE: 37 C.F.R. § 1.28(b) requires "Notification of any change in loss of entitlement to small entity status must be filed in the application . . . prior to paying, or at the time of paying . . . issue fee." From the wording of 37 C.F.R. § 1.28(b): (a) notification of change of status must be made even if the fee is paid as "other than a small entity" and (b) no notification is required if the change is to another small entity.

☒ 37 C.F.R. § 1.492(e) and (f) (surcharge fees for filing the declaration and/or filing an English translation of an International Application later than 30 months after the priority date).

Michael E. Hudzinski

SIGNATURE OF PRACTITIONER

Reg. No.: 26,482 / 34,185

James W. McKee / Michael E. Hudzinski

(type or print name of practitioner)

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FAY, SHARPE, FAGAN, MINNICH & McKEE, LLP

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Customer No.:

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EXPRESS MAIL CERTIFICATE

"Express Mail" EL 852678545 US
Date of Deposit: May 4, 2001

I hereby certify that this **PRELIMINARY AMENDMENT** is being deposited with the United States Postal Service "Express Mail Post Office to Addressee" service under 37 C.F.R. 1.10 on the date indicated above and is addressed to: Assistant Commissioner For Patents, Washington, D.C. 20231

By Barbara J. Whaley
Barbara J. Whaley

PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of:
C. PETER, et al.

Serial No.: Unknown

Filed: Herewith

For: **ELECTROMOTIVE DRIVE SYSTEM FOR USE WITH A PUMP OF A POWER-ASSISTED STEERING SYSTEM IN A MOTOR VEHICLE**
(As Amended)

Date of Last Office Action:
None

Atty Docket No.: TRW 2 0269

Examiner: Unknown

Art Unit: Unknown

Cleveland, OH 44114
May 4, 2001

PRELIMINARY AMENDMENT

Assistant Commissioner for Patents
Washington, DC 20231

Dear Sir:

Prior to substantive examination of the above-referenced patent application, applicant respectfully requests amendment of the application as follows:

IN THE TITLE:

Please amend the Title of the Invention to read as follows:

--ELECTROMOTIVE DRIVE SYSTEM FOR USE WITH A PUMP OF A POWER-ASSISTED STEERING SYSTEM IN A MOTOR VEHICLE--.

IN THE CLAIMS:

Please **cancel claims 2-9** from further consideration herein.

Please **amend claim 1** to read as follows:

1. (Amended) Electromotive drive comprising:

a housing, which has a shaft support, in which the shaft of a rotor is rotationally mounted;

a stator having drive windings, said stator being traversed and retained by the shaft support, whereby the stator is substantially retained in only transversal direction by the shaft support and connected with the remaining housing for transmission of torque in rotationally fixed manner; and

a base plate upon which the stator is arranged, said base plate being designed as a punched-out grid whereby transmission of torque moment from the stator to motor housing occurs via the base plate fastened in the housing.

Please **add new claims 10-28** as follows:

10. (new) An electromotive drive comprising:

a housing having an upwardly extending shaft support;

a base plate essentially rigidly attached to the housing;

a stator which essentially surrounds the shaft support, said stator further being essentially rigidly attached to the base plate whereby torque transmission occurs from the stator to the housing across the base plate;

a shaft rotatably arranged within the shaft support;

a rotor essentially rigidly attached to the shaft and essentially surrounding the stator; and

a coupling which couples the stator with the shaft support, said coupling being essentially incapable of transmitting torque therebetween.

11. (new) The electromotive drive as set forth in claim **10**,
wherein a gap is formed between an inner wall of the stator and an outer wall of the shaft support.

12. (new) The electromotive drive as set forth in claim **11**, wherein the coupling includes a viscous medium disposed in the gap.

13. (new) The electromotive drive as set forth in claim **11**, wherein the coupling includes grease material disposed in the gap.

14. (new) The electromotive drive as set forth in claim **11**, wherein the coupling includes at least one flexible element which essentially bridges the gap.

15. (new) The electromotive drive as set forth in claim **14**, wherein the at least one flexible element includes a vibration damping element.

16. (new) The electromotive drive as set forth in claim **14**, wherein:
grooves are provided in the outer wall of the shaft support; and,
the at least one flexible element includes an O-ring retained in said grooves.

17. (new) The electromotive drive as set forth in claim **10**, wherein the base plate includes means disposed essentially underneath the base plate for torque coupling between the base plate and the housing.

18. (new) The electromotive drive as set forth in claim **17**, wherein the means for torque coupling includes at least one of a surface roughening, a denticulation, and a

fluting, said torque coupling means operating in conjunction with a press-on pressure between the base plate and a surface of the motor housing.

19. (new) The electromotive drive as set forth in claim **17**, wherein the base plate further includes a punched-out grid.

20. (new) The electromotive drive as set forth in claim **19**, wherein the means for torque coupling further includes at least one conductor tract of the punched-out grid.

21. (new) The electromotive drive as set forth in claim **20**, wherein the conductor tract additionally serves for establishing electrical contact between the housing and the stator.

22. (new) The electromotive drive as set forth in claim **21**, wherein the base plate further includes a plastic extrusion coating.

23. (new) An electromotive drive comprising:

a housing having an upwardly extending shaft support;

a base plate essentially rigidly attached to the housing;

a stator which essentially surrounds the shaft support, the stator and the shaft support together defining a gap therebetween, the stator further being essentially rigidly attached to the base plate;

a shaft rotatably arranged within the shaft support;

a rotor essentially rigidly attached to the shaft and essentially surrounding the stator; and

a coupling which couples the stator with the shaft support, said coupling being essentially incapable of transmitting torque therebetween.

24. (new) The electromotive drive as set forth in claim **23**, wherein the coupling includes a viscous medium disposed in the gap.

25. (new) The electromotive drive as set forth in claim **23**, wherein the coupling includes at least one O-ring arranged in the gap.

26. (new) The electromotive drive as set forth in claim **23**, wherein the coupling includes a vibration damping means for damping vibrations of said stator.

27. (new) A pump motor, operant in conjunction with a pump for a hydraulic system of a motor vehicle, the pump motor comprising:

a housing having an upwardly extending shaft support;

a base plate essentially rigidly attached to the housing;

a stator essentially rigidly attached to the base plate and essentially surrounding the shaft support;

a shaft rotatably arranged in the shaft support;

a rotor essentially rigidly attached to the shaft and essentially surrounding the stator; and

a coupling between the stator and the shaft support, said coupling being flexible and essentially non-rigid.

28. (new) The pump motor as set forth in claim **27**, wherein:

the stator and the shaft support together define a gap therebetween; and

the coupling is disposed within the gap.

REMARKS

A marked-up version of amended claim 1 showing the changes is attached to the end of this document.

Applicants respectfully request that the foregoing amendments be entered prior to substantive examination of the application. These changes are submitted to place the application in better form for examination.

Respectfully submitted,

FAY, SHARPE, FAGAN, MINNICH, & McKEE, LLP

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MARKED UP VERSION OF AMENDED CLAIM 1

1. (Amended) Electromotive [Drive, especially for the Pump of a Power-Assisted Steering System of a Motor Vehicle,] drive comprising:

[(a)] [with] a housing [(3)], which has a [bearing journal] shaft support [(15)], in which the shaft [(18)] of a rotor [(9)] is rotationally mounted[, and];

[(b)] [with] a stator [(7)] having drive windings, said stator being traversed and retained by the [bearing journal] shaft support [(15)],

[(c)] whereby the stator [(7)] is substantially retained in only transversal direction by the [bearing journal] shaft support [(15)] and connected with the remaining housing [(3)] for transmission of torque in rotationally fixed manner[,]; and

[**characterized in that**]

[(d)] [the stator [(7)] is arranged on] a [support] base plate [(19)] upon which the stator is arranged, said base plate being designed as a punched-out grid [and that] whereby transmission of torque moment from the stator [(7)] to motor housing [(3)] occurs via the [support] base plate fastened in the housing.

Sub. Spec.

09/831287
8 Rec'd PCT/PTO 04 MAY 2001
TRW 2 0269

ELECTROMOTIVE DRIVE SYSTEM FOR USE WITH A PUMP OF A POWER-ASSISTED STEERING SYSTEM IN A MOTOR VEHICLE

Background of the Invention

The invention relates to an electromotive drive system especially suited for use with a pump of a power-assisted steering system of a motor vehicle of the type having a housing, a shaft support containing a shaft on which a rotor is rigidly affixed, and a stator with drive windings which is traversed and retained by the shaft support.

As a rule, electromotive pumps are employed with power-assisted steering systems. In these pumps, the motors are typically designed in such a manner that the pumps are operated at full load for only brief periods of time. When the prior art motors with integrated hydraulic power-assisted steering system pumps are operated at full load, disturbing whistling noises are often generated which are attributable to relatively high frequency torque variations.

Known electromotive drives and pumps have an electric motor including a stator and a rotor. The rotor is typically an external rotor that encompasses the stator. The stator is positioned on a shaft support which extends through the stator and is firmly connected with the stator. In addition, for transmission of the torque from the stator to the remaining housing, an axial split pin is installed between the stator and the shaft support. The axial pin is arranged between opposite recesses formed in the interior wall of the stator and the exterior wall of the shaft support. At the underside of the stator, the connecting contacts of the stator windings are joined with a base plate arranged between the stator and the bottom of the housing. The control electronics for the motor or the pump are also typically arranged on the base plate.

In prior art motors, the axial split pin is provided for non-positive and positive coupling of the

stator and the shaft support. The axial split pin engages with corresponding grooves in the inner wall of the stator and the outer wall of the shaft support. The split pin of the prior art creates a rigid coupling between the rotor masses and the mass of the remaining drive. As a result, the resonant frequency of the combined stator and shaft support system lies within the range of the high frequency torque variations occurring during operation. Thus, the stator/shaft arrangement of the prior art systems are incited to produce disturbing, noise-producing vibrations.

Proceeding from said state of the art, it is an object of the invention to create an electromotive drive system, and particularly an electromotive drive for the pump of a power-assisted steering system of a motor vehicle, for which the disturbing noises occurring with known drives are drastically reduced or prevented.

Summary of the Invention

The invention proceeds from the recognition that the disturbing noises are typically created by the substantially rigidly coupled stator/shaft support system, which generates a “tuning fork” effect when the resonant frequency of the system falls in the range of the unavoidable high frequency torque vibrations. Such torque variations or vibrations are practically unavoidable with electric motors and which have sufficient amplitude to lead to the disturbing noises, especially when the pump is operated with a full load.

According to one aspect of the invention, the rigid coupling between the stator and the shaft support is eliminated with respect to torque transmission. The transmission of torque moment occurs essentially only via the coupling of the stator with the remaining housing and not through the shaft support. The shaft support serves only for positioning the stator in the plane which extends transversely in relation to the shaft support. In the present invention, elimination of the split pin or similar

coupling means causing the rigid coupling has resulted in a clear reduction of the disturbing noises.

An improved suppression of the disturbing noises is obtained by providing a gap between the interior wall of the stator and the outer wall of the shaft support. The gap is preferably filled at least partially with a viscous medium. Alternatively, or in addition, vibration-absorbing elements are preferably included, for example O-rings, for bridging the gap and coupling the stator and the shaft support. The coupling, however, preferably does not substantially transmit torque. As a result of these measures, further improved noise suppression is achieved. Preferably, the substantially reduced torque transmission at the coupling between the stator and the shaft support alters the resonance properties, e.g. the resonant frequency and damping, of the rotor/shaft support system such that the disturbing noises are essentially eliminated.

In a preferred embodiment, the torque transmission from the stator to the remaining housing takes place via a supporting base plate. The base plate preferably includes a punched-out grid. The stator is mounted onto the supporting base plate. This arrangement results in a very simple installation, while at the same time substantially dampens high frequency torque variations or vibrations through the flexibility and damping properties of the base plate, and the overall stator/base plate system. Vibrations of the entire housing, and the detrimental excitation of the rotor/shaft support system potentially excited thereby, are thus reduced or suppressed.

In the present invention, in order to avoid a mechanical overload of the base plate, particularly in the case of a base plate having small dimensions, a means is preferably provided at the base plate for non-positive and/or positive torque transmission to the remaining housing. For example, the means include one or more of a surface roughening, denticulation, and fluting on the underside of the base plate. These features produce, in

conjunction with appropriate press-on pressure of the plate against the housing, an improved coupling for torque transmission. The roughening, denticulation, or fluting are provided, as desired, at non-plastic-coated conductor tracks of the punched-out grid of the supporting base plate. In this manner, simultaneous electrical contacting of the housing occurs, for example by mass potential.

Brief Description of the Drawings

The invention may take form in various components and arrangements of components, and in various steps and arrangements of steps. The drawings are only for the purpose of illustrating preferred embodiment and are not to be construed as limiting the invention.

FIGURE 1 is a perspective exploded view of the basic components of an electromotively driven pump with a drive in accordance with one embodiment of the invention; and

FIGURE 2 is a central, vertical longitudinal sectional view of the embodiment of FIGURE 1 in the fully assembled state.

Detailed Description of the Preferred Embodiment

FIGURE 1 depicts an electromotively driven pump **1** which includes a housing **3**, an electronic control unit **5**, a stator **7** and a rotor **9**. A protective hood **10** (Fig. 2) joins with the housing **3** and covers the motor. Although the invention will be described with particular reference to the illustrated preferred pump embodiment as shown in FIGURES 1 and 2, the drawings are exemplary only and are not to be construed as limiting the invention to any particular application.

The housing **3** contains the pumping mechanism and has in an anterior wall a high pressure outlet **11** and in a rear wall an inlet **13** in the area indicated in FIGURE 1.

A cylindrical shaft support **15** extends upwardly from the bottom of the housing **3**. The shaft support **15**

contains the driven shaft **18**. The shaft **18** is supported in the shaft support **15** by bearings **17**. The shaft **18** drives the pumping mechanism. The housing **3** preferably consists of aluminum or magnesium cast metal.

The electronic control unit **5** is arranged in the housing **3**. The electronic control unit **5** includes a base plate **19** onto which the mechanical, electrical, electro-mechanical and electronic components are attached. The base plate **19** has a recess **21** which engages the shaft support **15** of the housing **3**. The base plate **19** includes an extrusion-coated punched-out grid which supports high current densities, and a printed conductor plate for conducting low current densities.

The motor includes a stator **7** having stator windings. The stator **7** also has an axial recess **25** which receives the shaft support **15** of the housing **3**. The stator **7** is rigidly fastened to the base plate **19**, e.g. via a punched-out grid. For example, the stator **7** may be fastened to the base plate **19** by soldering or welding the contact connections of the stator **7** windings to the conductor tracks of the punched-out grid.

The rotor **9** is constructed as an external rotor and is rotationally arranged in the housing **3** by a rigid connection to the shaft **18** which in turn is held by the bearings **17**. The rotor **9** joined with the drive shaft **18** by any suitable appropriate fashion.

The entire arrangement is preferably covered by the protective hood **10** as shown in FIGURE 2. The protective hood **10** connects with a collar **27** of a lateral wall of the housing **3**.

A pair of receptacles **29** are provided in the housing **3** and are adapted to receive power semiconductors **31** of the electronic control unit **5**. The power semiconductors **31** are preferably power FET's. The power FET's normally have small heat sinks **31a** which cannot guarantee adequate heat transfer.

To that end, the small heat sinks **31a** are disposed

on the receptacles **29** in the housing **3** and are so arranged as to have sufficient thermal contact with the housing **3** using any suitable means.

Since the heat sinks **31a** of the power semiconductors **31** also preferably function as electrical contacts, there is preferably provided an electrically insulating but thermally conducting layer between a back side of the small heat sinks **31a** and the receptacles **29**. Alternatively, a direct electrically conducting contact between the heat sinks **31a** and the housing **3** is established, conditional upon the heat sinks **31a** not simultaneously acting as electrical contacts.

In the particular represented embodiment, two power semiconductors **31** are included, and are attached to the receptacles **29** by elastic clamps **33**.

The regions of the housing **3** below the receptacles **29** preferably have one or more channels through which flows the fluid to be transported by the pump **1**. These regions thus act as heat exchangers for transferring heat out of the power semiconductors **31**. Of course, other measures known to the art can also be incorporated for improving the heat sinking of the power semiconductors **31**. For example, it is preferable to maximize the area through which the fluid is transported in the regions below the receptacles **29**. A plurality of channels can be provided to increase the heat transfer. Additionally, one or more channels preferably includes interior cooling fins.

In order to avoid noises which develop with the prior art drives in use heretofore, which noises are caused by relatively high frequency variations of the generated torque moment, the stator **7** is not joined directly to the shaft support **15**. Rather, the shaft support **15** and the stator **7** are arranged such that a gap exists between an inner wall of the stator **7** and an outer wall of the shaft support **15**.

In order to attain adequate fixation of the stator **7** while yet providing the gap, one or more O-rings **12** are

arranged in grooves **12a** in the outer wall of the shaft support **15**. The O-rings **12** are preferably sufficiently flexible to minimize undesired rigid coupling between the stator **7** and the shaft support **15**. The O-rings **12** preferably have flexibility and produce a dampening effect, thus acting as vibration-damping coupling elements between the stator **7** and the shaft support **15**.

In place of the O-rings **12** or in addition to these O-rings, the gap may also be filled partially with a viscous medium such as a grease, which also avoids or further reduces the rigidity of the coupling.

It is to be appreciated that in the preferred embodiment, a substantially rigid coupling between the stator **7** and the shaft support **15** is avoided, as a rigid coupling would support tangential power transmission or the transmission of the torque from the stator **7** to the shaft support **15**.

According to the embodiment illustrated in FIGURES 1 and 2, the torque moment is not transmitted from the stator **7** through the shaft support **15**. Rather, the torque moment is transmitted directly to the housing **3**, and, more specifically, to the bottom of the housing **3**. The shaft support **15**, aside from providing a mounting for the rotor shaft **18**, serves only to provide axial control or stabilization of the stator **7**.

According to the embodiment illustrated in FIGURES 1 and 2, the stator **7** is firmly joined with the supporting base plate **19**. As mentioned previously, this joining is preferably realized by soldering or welding of connection contacts to the conductor tracts of the punched-out grid of base plate **19**.

Since the base plate **19** is firmly mounted, together with the attached stator **7** in the housing **3**, the torque moment transmission from the stator **7** to the to the housing **3** takes place via the base plate **19**. This arrangement produces an additional benefit in that the base plate **19**, which typically has some flexibility, acts to

dampen the high frequency variations of the transmitted torque. This additional benefit is obtained in particular when the base plate **19** is at least partially formed as an extrusion plastic-coated punched-out grid.

The vibration dampening properties of the base plate **19** are particularly evident when the base plate **19** is not rigidly connected over its entire area with the housing **3**, but rather is connected only in certain selected areas or spots, e.g. is connected by means of screws.

In order to provide reliable safe transmission of torque moment and to avoid a mechanical overload or destruction of the base plate **19**, the base plate **19** is preferably appropriately dimensioned, or additional measures are preferably taken to promote transmission of torque. To that end, in the preferred embodiment means is preferably provided on the base plate **19**, preferably in the attachment region of the stator **7**, for positive and/or non-positive coupling with the housing **3**. Said means are, preferably, a surface roughening or denticulation disposed on the underside of the base plate **19**, which act in conjunction with press-on forces operating in these regions to provide improved torque moment transmission to the housing **3**. This roughening or denticulation is preferably provided on non-plastic coated conductor tracts. These conductor tracts therefore also selectively act as electrical contacts with the housing **3**.

Extensions which extend downwardly are also selectively provided at the underside of the plate as desired to promote torque transmission. Such extensions preferably cooperate with stops provided in the housing **3** for the transmission of torque moment.

Overall, as a result of the inventive construction, undesirable noise-producing vibrations of prior art stator/shaft support systems are avoided. The shaft support **15** serves only for axial and transverse fixation of the stator **7**, while transmission of the torque moment occurs through a twist-proof fastening of the stator

in the housing **3**, preferably by means of a base plate **19**.

The invention has been described with reference to the preferred embodiment. Obviously, modifications and alterations will occur to others upon reading and understanding the preceding detailed description. It is intended that the invention be construed as including all such modifications and alterations insofar as they come within the scope of the appended claims or the equivalents thereof.

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Translation

Electromotive Drive, especially for the Pump of a Power-Assisted Steering System of a Motor Vehicle.

The invention relates to an electromotive drive, especially for the pump of a power-assisted steering system of a motor vehicle with the characteristics of the preamble of Patent Claim 1.

As a rule, electromotive pumps are employed with power-assisted steering systems, whereby the engines are designed in such manner that these are operated at full load for only a brief period of time. In particular, when known engines and/or pumps for the hydraulics of the power-assisted steering system designed as an integral part of the former are operated at full load, disturbing whistling noises are generated which, obviously, are attributable to relatively high-frequency torque variations.

Known electromotive drives and/or electromotive pumps have an electric motor, which comprises a stator and a rotor, with the latter being realized as external rotor which encompasses the stator. The stator is positioned on a bearing journal which extends through the stator and is firmly connected with same. In addition, for transmission of the torque from the stator to the remaining housing, an axial split pin is installed between stator and bearing journal, in opposite recesses in the interior wall of the stator and the exterior wall of the bearing journal. At the underside of the stator, the connecting contacts of the stator windings are joined with a plate arranged between stator and housing bottom, on which is provided the control electronics for the engine or the pump.

Proceeding from said state of the art, it is the object of the invention to create an electromotive drive, especially for the pump of a power-assisted steering system of a motor vehicle, for which the disturbing noises occurring with known drives are largely prevented, at least, however, are drastically reduced.

The invention solves said object with the characteristics of Claim 1.

The invention proceeds from the recognition that the disturbing noises are presumably created by the substantially rigidly coupled stator/bearing journal system, which generates a 'tuning fork' effect when the resonant frequency of the system falls in the range of the unavoidable high-frequency torque variations, which are practically unavoidable with electric motors and which, primarily with full load, have sufficient amplitude to lead to the disturbing noises.

According to the invention, with respect to the torque transmission, the rigid coupling between stator and bearing journal is eliminated. The transmission of the torque moment substantially occurs only via the coupling of the stator with the remaining housing (disregarding the bearing journal). The bearing journal serves only for mounting the stator in the plane which extends in transverse direction vis-a-vis the axis of the bearing journal. In actual practice, elimination of the split pin (or similar coupling means) causing the rigid coupling has resulted in a clear reduction of the disturbing noises.

An improved suppression of the disturbing noises is obtained by providing a gap between the interior wall of the stator and the outer wall of the bearing journal, whereby the gap is preferably filled, at least in part, with a viscous medium. Instead, or additionally, flexible, preferably

vibration-absorbing elements may be provided, for example O-rings, for bridging the gap between coupling of stator and bearing journal. The coupling, however, must not be designed in such fashion that torque transmission may substantially be facilitated. As a result of these measures, further improved noise suppression was achieved. Although the effect of these measures have not been clarified to the last detail, one may assume that as a result of the non-torque transmitting coupling mode between stator and bearing journal, the resonance properties (resonance frequency and damping) of the rotor/bearing journal system are altered in a way so that hardly any disturbing noises are produced.

In the preferred embodiment of the invention, the torque transmission from the stator to the remaining housing takes place via a support plate, which may be designed as a punched-out grid. The stator itself is mounted on the support plate. This results, on the one hand, in very simple installation, - on the other hand, high-frequency torque variations can be greatly damped by the flexibility and damping properties of the support plate and/or the stator/support plate system. Vibrations of the entire housing and, possibly, any resulting excitation of the rotor/bearing journal system are hereby reduced or suppressed.

In order to avoid a mechanical overload of the support plate, particularly if same has small dimensions, means may be provided at the support plate for non-positive and/or positive torque transmission to the remaining housing, for example in form of surface roughening, denticulation or fluting on the underside of the support plate which produce, jointly with appropriate press-on pressure of the plate against the housing, an improved coupling for torque transmission. Said roughening, denticulation or fluting can be provided, for example at non plastic-coated conductor tracks of the punched-out grid realizing the support plate. In this manner simultaneous electrical contacting of the housing can occur, for example, by mass potential.

Additional specific embodiments of the invention are apparent from the sub-claims.

In the following, the invention is explained in greater detail making use of one of the specific embodiments represented in the drawing . The drawing depicts the following:

Fig. 1. a perspective exploded representation of the basic components of an electromotively driven pump with a drive according to the invention;

Fig. 2. a central, vertical longitudinal section through the pump in Fig. 1 in fully-mounted state.

Fig. 1 depicts an electromotively driven pump 1, comprising a housing 3, an electronic selection device 5 and also a stator 7 and a rotor 9. A protective hood for covering the motor, which can be joined to the housing, is also depicted in Fig. 2. Needless to say, the invention is not limited to the represented embodiment for which the inventive drive is designed as an integral part of the pumping mechanism. Instead, such drive can be realized by itself or integrated jointly with other driven devices.

Housing 3 includes the entire pumping mechanism and has in the anterior wall an outlet aperture 11 (pressure exit) and in its rear wall a take-in aperture 13 (not shown in more detail).

Starting from the bottom of housing 3, a cylindrical wall or bearing journal 15 extends in upward direction, in which is provided the driven shaft 18 of the drive which is mounted by means of

bearings 17, said driven shaft serving, at the same time, as drive shaft for the pumping mechanism.

Housing 3 preferably consists of aluminum- or magnesium cast metal.

The electronic selection device 5 is arranged in housing 3. It includes a plate 19, on which are provided the necessary mechanical, electrical, electro-mechanical and electronic components. Plate 19 has a recess 21 in which engages the bearing journal 15 of housing 3. Plate 19 is designed as a combination of an extrusion-coated punched-out grid (for high current intensities) and a printed conductor plate (for low current intensities).

Motor 7 (!?) has a stator 7 with the required number of stator windings. Stator 7 likewise has an axial recess 25 by means of which stator 23 is placed on the bearing journal of housing 3. Stator 7 is firmly fastened to the plate 19, in particular to the respective punched-out grid, for example by means of soldering or welding of the winding contact connections with the conductor tracks of the punched-out grid.

The rotor 9 is constructed as external rotor and is rotationally arranged in housing 3 by means of the firmly with the rotor connected drive shaft 18 and bearing 17. Needless to say, rotor 9 is joined with the drive shaft 18 in the appropriate fashion.

The entire arrangement is covered by a protective hood, represented in Fig. 2; said protective hood is placed on the collar 27 of the lateral wall of housing 3.

In housing 3 are provided two placement areas 29 for power semi-conductors 31 of the electronic selection device 5. These power semi-conductors may involve, for example, Power-FET's. The power FET's normally have relatively small cooling bodies 31a, which generally, however, cannot guarantee adequate transport of leakage heat.

To that end, the small cooling bodies 31a are placed on the placement areas 29 in housing 3 and are brought into adequate heat conducting contact with same via suitable means.

Since the cooling bodies 31a of the power semi-conductors 31 fulfill, at the same time, also the function of an electrical contact, there may be provided, if necessary, between the rear side of the small cooling bodies 31a and the placement areas 29 an electrically isolating, but adequately heat conductive layer. If appropriate, however, a direct electrical contact between the cooling bodies 31a and housing 3 may also be established, should this be electrically permitted or desired.

In the particular represented embodiment, two each power semi-conductors 31 are attached to the placement surfaces 29 by means of elastic clamps 33.

The regions of housing 3 below the placement surfaces 29 preferably have one or several channels through which flows the medium to be transported by the pump. The corresponding regions thus act like heat exchangers. Needless to say, to that end, measures known by themselves can also be provided for improving the transport of heat from the power semi-conductors 31,

such as, for example, the provision of an area as large as possible for the medium to be transported in the regions below the placement regions 29. A multitude of channels may, for example, be provided to that end, or one or several channels may have interior cooling fins.

In order to avoid noises which develop with the standard drives and which occur in actual practice, caused by relatively high-frequency variations of the generated torque moment, the inventive stator 7 is not joined directly to the bearing journal in non-positive fashion. Instead, the bearing journal 15 and the stator 7 are dimensioned in such way that a gap is formed between the inner wall of the stator and the outer wall of the bearing journal. The axial split pin provided in known motors for non-positive and positive coupling of stator 7 and bearing journal, which engages in corresponding grooves in the inner wall of the stator and outer wall of the bearing journal, is eliminated in the construction according to the invention. Said split pin would create a rigid coupling of the rotor masses with the mass of the remaining drive, as a result of which the resonant frequency of the totality of the stator/bearing journal system would again come within the range of the high-frequency torque variations occurring over the entire operating range. Said stator/bearing journal system would then again be incited to produce the disturbing, noise-producing vibrations.

In order to nevertheless attain adequate fixation of the stator 7, one or several O-rings 12 (as depicted in Fig. 2) may be provided in grooves 12a in the outer wall of the bearing journal 15. These O-rings must be sufficiently flexible so that no unwelcome rigid coupling is created between stator 7 and bearing journal 15. Thus, the O-rings in their flexibility and damping property serve the function of vibration-damping coupling elements between stator and bearing journal.

Instead of the O-rings 12 or in addition to these O-rings, the gap may also be filled (partially) with a viscous medium, for example fat. This also avoids or further reduces rigid coupling.

At any rate, a substantially rigid coupling between stator 7 and bearing journal 15 is to be avoided, which would entail a tangential power transmission or the transmission of the torque from the stator to the bearing journal.

According to the invention, the torque moment is not transmitted from the stator 7 via the bearing journal 15, but directly to the housing 3 or the bottom of the housing. The bearing journal 15, aside from the mounting of the rotor shaft 18, serves only for axial control or fixation of the stator.

According to the embodiment of the invention represented in the drawing, the stator is firmly joined with the support plate, realized in the form of plate 19. As mentioned previously, this can be done by means of soldering or welding of connection contacts to the conductor tracts of the punched-out grid representing plate 19.

Since plate 19 is firmly mounted, together with the thereon attached stator 7, in housing 3, the torque moment transmission from the stator to the housing can take place via plate 19. This produces the additional benefit that the plate, with its practically always existing flexibility, serves for damping the high-frequency variations of the torque moment to be transmitted. This applies in particular with respect to the design (at least in part) of plate 19 as extrusion plastic-coated punched-out grid.

The vibration-damping properties of plate 19 come particularly to light when the plate it not rigidly connected, over the entire area, with housing 3, but only in partial areas, or in spots, for example by attaching the plate to the housing by means of screws.

In order to ensure safe transmission of torque moment and to avoid a mechanical overload or destruction of the plate, same must either be appropriately dimensioned or additional measures must be taken to promote transmission of torque. To that end, preferably in the attachment region of the stator, means may be provided on the plate for positive and/or non-positive coupling with the housing. Said means can be realized, for example, in form of surface roughening or denticulation on the underside of the plate, which assure, concurrently with press-on forces operating in these regions, an improved torque moment transmission to the housing. Said roughening or denticulation can preferably be provided on non-plastic coated conductor tracts, which may, at the same time, serve for establishing electrical contact with the housing.

Needless to say, extensions extending in downward direction may also be provided for said purpose at the underside of the plate, which cooperate with stops provided in the housing for the transmission of the torque moment.

All in all, as a result of the inventive construction, disturbing noise-producing vibrations of the stator/bearing journal system are avoided in that the bearing journal merely serves for axial and transverse fixation of the stator and that transmission of the torque moment is assured by twist-proof installation of the stator in the housing, preferably by means of a support plate.

Electromotive Drive, especially for the Pump of a Power-Assisted Steering System of a Motor Vehicle.

Patent Claims

1. Electromotive Drive, especially for the Pump of a Power-Assisted Steering System of a Motor Vehicle,

   a) with a housing (3), which has a bearing journal (15), in which the shaft (18) of a rotor (9) is rotationally mounted, and

   b) with a stator (7) having drive windings, said stator being traversed and retained by the bearing journal (15),

   characterized in that

   c) the stator (7) being substantially retained only transversally by the bearing journal (15) and connected with the remaining housing (3) for transmission of torque in rotationally fixed manner.

2. Drive according to Claim 1, **characterized in that** a gap is provided between the inner walls of the stator (7) and the outer wall of the bearing journal (15).

3. Drive according to Claim 2, **characterized in that** the gap (8) is filled with a viscous medium, preferably with fat.

4. Drive according to Claim 2 or 3, **characterized in that** the stator (7) is coupled with the bearing journal (15) by means of gap (8)-bridging, flexible, preferably vibration-damping elements (12).

5. Drive according to Claim 4, **characterized in that** the flexible elements (12) are O-rings, which are retained in grooves (12a) in the outer wall of the bearing journal (15).

6. Drive according to one of the preceding Claims, **characterized in that** the stator (7) is arranged on a support plate (19), preferable designed as punched-out grid and that the torque transmission from stator (7) to the motor housing (3) takes place via the support plate fastened in the housing.

7. Drive according to Claim 6, **characterized in that**, relative to the torque transmission, means are provided at the underside of the support plate (19) for non-positive or positive coupling of the support plate with the motor housing (3).

8. Drive according to Claim 7, **characterized in that** said means comprise roughening, denticulation or fluting and that the non-positive coupling is created by press-on pressure of the support plate (19) against an installation area of the motor housing (3).

9. Drive according to Claim 7 or 8, **characterized in that** the support plate (19) is designed as plastic extrusion-coated punched-out grid and that the means for non-positive and/or positive coupling of the support plate with the motor housing (3) are provided in the non-plastic coated regions of one or several conductor tracts of the punched-out grid.

10. Drive according to Claim 9, **characterized in that** the means for non-positive and/or positive coupling of the support plate (19) with the motor housing (3) serves, at the same time, for establishing contact with the motor housing, for example, by mass potential.

Electromotive Drive, especially for the Pump of a Power-Assisted Steering System of a Motor Vehicle.

Abstract

The invention relates to an electromotive drive, especially for the pump of a power-assisted steering system of a motor vehicle. Said drive comprises a housing (3) with a bearing journal (15) in which the shaft (18) of a rotor (9) is rotationally mounted. The drive also comprises a stator (7) having drive windings. The bearing journal (15) extends through said stator and supports it. The stator (7) is supported by the bearing journal (15), substantially in the transversal direction only. The stator (7) is coupled with the remaining housing (3) in a rotationally fixed manner, so as to transmit the engine torque. The inventive design provides a means for dramatically reducing disturbing noises which occur especially when the motor is operated at full load and which are caused by relatively high-frequency torque variations.

Principal drawing is Fig. 2

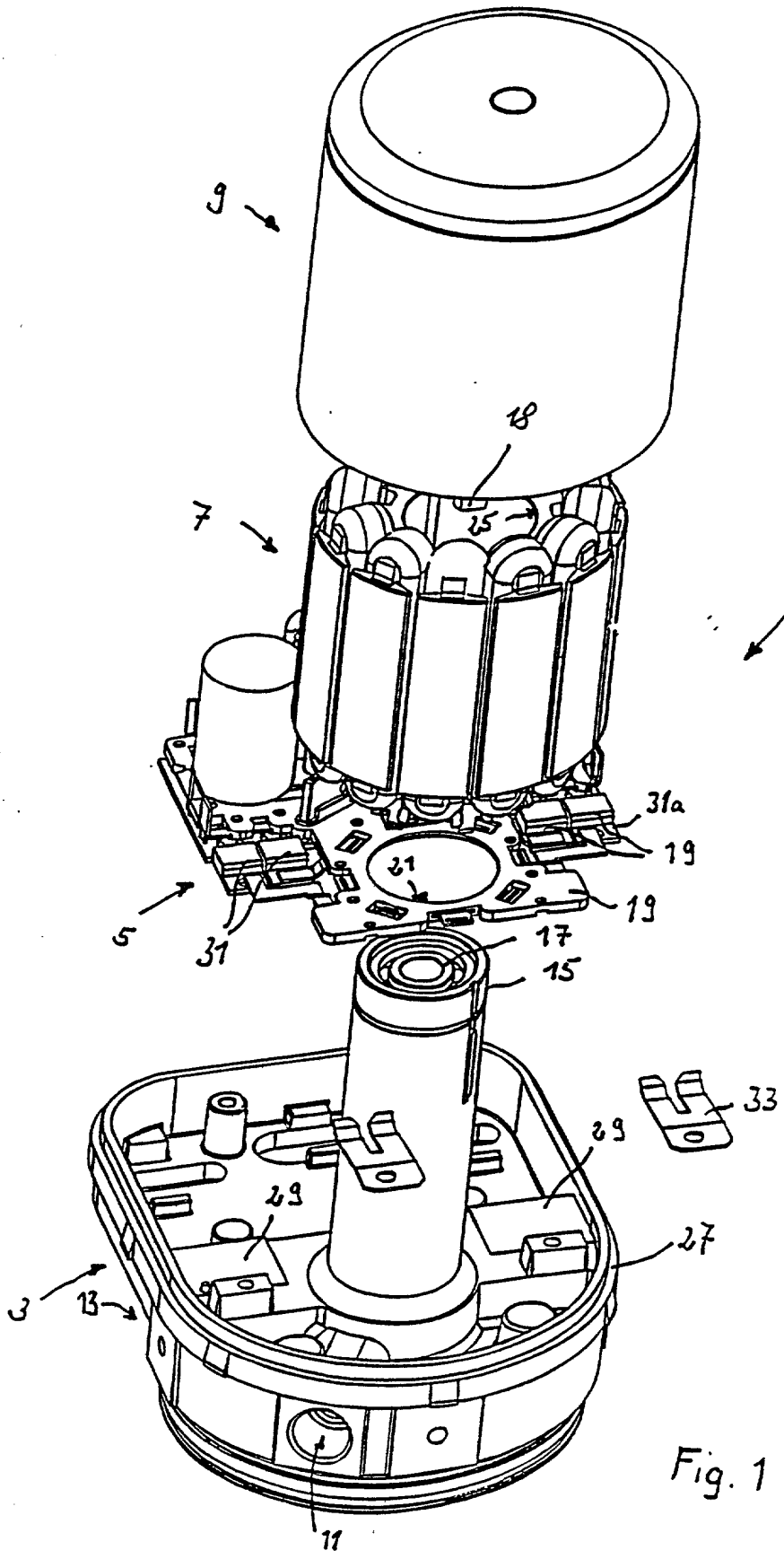

Fig. 1

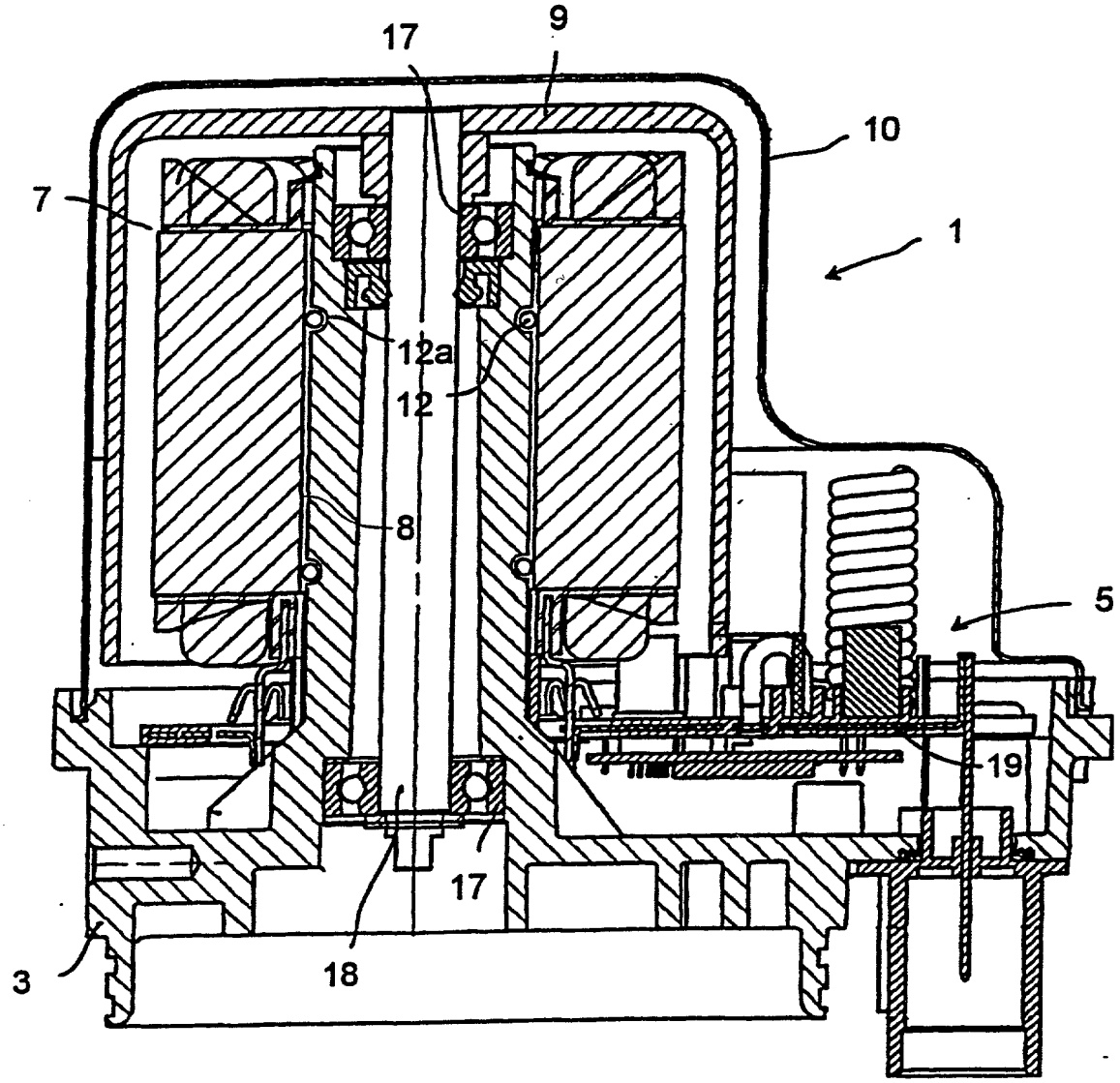

Fig. 2

Attorney Docket No.: TRW 2 269

DECLARATION FOR PATENT APPLICATION

As the below named inventors, we hereby declare that:

Our residence, post office address, and citizenship are as stated below next to our names.

We believe we are an original, first, and joint inventor of the subject matter which is claimed and for which a patent is sought on the invention entitled:

ELECTROMOTIVE DRIVE SYSTEM FOR USE WITH A PUMP OF A POWER-ASSISTED STEERING SYSTEM IN A MOTOR VEHICLE
(As Amended)

the specification of which was filed on May 4, 2001 and was amended on May 4, 2001 by way of Preliminary Amendment and Voluntary Submission of Substitute Specification and accorded Serial No. 09/831,287.

We hereby state that we have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment referred to above.

We acknowledge the duty to disclose information which is material to the examination of this application in accordance with Title 37 Code of Federal Regulations § 1.56(a).

We hereby claim foreign priority benefits under Title 35, United States Code § 119 of any foreign application(s) for patent or inventor's certificate listed below and have also identified below any foreign application for patent or inventor's certificate having a filing date before that of the application on which priority is claimed:

Germany 198 51 060.8 Filed November 5, 1998

We hereby claim the benefit under Title 35, United States Code, § 119(e) of any United States provisional application(s) listed below:

Not applicable.

We hereby claim the benefit under Title 35, United States Code, § 120 of any United States application(s) listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States application in the manner provided by the first paragraph of Title 35, United States Code § 112, I acknowledge the duty to disclose material information as defined in Title 37, Code of Federal Regulations, § 1.56(a) which occurred between the filing date of the prior application and the national or PCT international filing date of this application:

PCT Application No. PCT/DE99/03472, Filed October 29, 1999

We hereby appoint the following attorney(s) and/or agent(s) to prosecute this application and to transact all business in the Patent and Trademark Office connected therewith:

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We hereby declare that all statements made herein of our own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

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